Accident Detection and Rescue Alert System

# Ms. E. Annapoorna,1 **T**. Parthiv Patel, 2 C. Praneeth, 3 P. Jai Sanjay

*Department of AIMLE, GRIET,   
UG Department of AIMLE, GRIET  
UG Department of AIMLE, GRIET  
UG Department of AIMLE, GRIET*

**Abstract:**

In the era of rapid modernization and continual advancements in transportation, the escalating frequency of accidents has emerged as a pressing concern. These tragic incidents claim numerous lives, representing a significant and disheartening cause of mortality in contemporary society. Acknowledging this urgent need for bolstered safety measures, the "Accident Detection and Rescue Alert System" emerges as a pivotal solution. It leverages state-of-the-art sensor technology to not only detect potential accidents but also to promptly alert rescue services. The accident detection mechanism vigilantly monitors the vehicle's dynamics, analyses variations in speed, and even utilizing auditory cues within the vehicle. When an accident scenario is identified, the system initiates an alert that lasts for five seconds. Following this, it promptly dispatches a notification to the nearest rescue team. This innovative integration of cutting-edge sensor technology and intelligent processing represents a significant stride towards mitigating the risks associated with accidents, ultimately aiming to save lives in critical situations.

# INTRODUCTION

IoT, which means Internet of Things is characterized as an arrangement of interrelated gadgets or substances comprising of sensors and knowledge associated by an organization that is liable for the execution of a mechanized software.The term Internet of Things was coined in 1999, by a Computer researcher by the name of Kevin Ashton.While working in Procter and Gamble, he thought of a thought of utilizing RFID(Radio Frequency Identification) chips on items to follow them through the production network. To draw in the consideration of chiefs, he chose to go with the word Internet, which was a famous topic of conversation at the time.His thought of utilizing the popular expression appeared to have worked, since now IoT has become one of the main advancements in the whole world. There are a bunch of uses going from home security to the whole argiculture industry being subject to IoT gadgets to set aside time and cash.

* 1. **Problem Statement**

The world's most dangerous mode of transportation is thought to be the road. As per the yearly report on road accidents by the Ministry of Road Transport and Highways, the states and Union Territories (UTs) documented 461,312 occurrences in 2022, resulting in 443,366 casualties. Compared to 2021, the year had a rise of 11.9% in accidents, 9.4% in fatalities, and 15.3% in injuries. Though Road Transport have become relatively much safer in the past decades, they still remain the cause for the most deaths in the transportation field. Road accidents are very common nowadays .Road safety is still a key problem for development, a public health issue, and the primary cause of fatalities and serious injuries worldwide. The World Health Organisation estimates that at least one in ten persons who die in traffic accidents worldwide are from India. Road accidents incur costs that are not only borne by the not only by the victims and their families, but also by the economy at large due to the premature deaths, injuries, disabilities, and lost wages. When a driver collides with a fixed object, such as a tree, a fence, or an anti-collision barrier,they are especially vulnerable. The majority of vehicle accident deaths are not instantaneous deaths but rather the result of delayed emergency assistance and rescue

1. **Working Principle**

The Internet of Things runs on the perfect transmission and receipt of data packets between linked devices, which enables things to communicate with external systems and with each other. This fundamental characteristic forms the basis for features like task automation, remote control, and data collection from numerous sources. A successful IoT ecosystem often consists of a few essential components. These comprise the data-gathering and data-processing sensors and actuators as well as the communication infrastructure required for device-to-device data exchange. IoT frameworks also require cloud-based platforms and services since they offer accessibility, management, storage, and analysis for users and systems. The power of the Internet of Things to automate and control remotely equipped Microprocessor, Iot is made up of networked devices and provides the framework for intelligent systems that increase production, efficiency, and safety. These internet-enabled devices perform tasks and automate judgement calls. The IoT facilitates seamless communication between components, which allows for a paradigm shift in the way systems operate. When real-time data is leveraged to give actionable insights, users and industries are enabled to explore new ideas, optimise operations, and make well-informed decisions. The convergence of technologies creates more flexible and adaptable environments, redefines problem-solving approaches, and increases overall system efficacy and efficiency..

1. **LITERATURE SURVEY**

**2.0. Existing Approaches**

The authors of [1],This Smart Helmet System represents an innovative solution tailored for drivers seeking enhanced awareness and safety during their journeys. While the concept of social interaction among vehicles is not new, our approach seeks to overcome existing limitations, offering a balance of advantages and disadvantages found in similar projects. Our primary focus is to make smart helmets affordable and user-friendly, ensuring widespread accessibility. This advanced helmet is designed to gather environmental data, assess rear visibility through object and proximity sensors, and detect nearby vehicles. By interpreting electrical signals from the motorcycle, including lights, speed, and tachometer data, the system wirelessly communicates with both the bike and the helmet module. To maximize efficiency, a helmet-mounted display alerts the rider to potential dangers as other vehicles approach. Careful consideration has been given to hardware selection, factoring in individual components' functionality and costs. While the project is self-financed, decisions regarding proximity sensors and image sensors are made with a keen eye on maintaining both functionality and affordability. Emphasizing driver safety, our smart helmet prioritizes key features without compromising security. Special attention has been directed towards preventing high-speed driving risks, reflecting our commitment to ensuring the well-being of riders.

The proposed method of [2], This project aims to use of intelligent braking systems can stop many accidents and save lives. Installing such intricate systems is frequently required, much like wearing seat belts. This implies that injuries are frequently prevented to some degree. After being integrated into a single car system, our intelligent braking technology provides a glimpse of long-term protection for your car and how these specific devices are further refined to prevent crashes and protect car occupants.. The proposed study [3], intends to support parked motorcycles using the side stand. The driver should strike and touch the ground in a non-distracting manner if they fail to fold the side stand beforehand. In a bend, the driver maintains control. To make sure the stand is in a released state, a day sensor is now employed From the centre, the motorbike side stands offset coil springs and metal rods. When parked, some side stands automatically retract. While some are fitted with electric locks, others have raised supports. A specific retraction mechanism or warning device. This material offers a chance to lessen the evident motorbike side stand that supports fully loaded automobiles in a parked position. When you need to get out of your automobile for a short duration, they work well for a fast halt. For further security, a spring return to the starting position will be supplied. The device being demonstrated comprises of a motorcycle battery powering a DC motor. Connect to the worm and worm gear system to reduce engine speed torque and increase speed. The motor is activated by a rotation sensor mounted on the front wheel.

The authors of [4],For all people, traffic accidents are a major concern. Numerous valuable lives are lost in auto accidents every day. This is the most crucial subject that requires in-depth investigation because of the high death rate associated with road accidents. The two most frequent causes are poor emergency response times and driver error. Efficient traffic collision detection and information exchange systems are necessary for injured rescue operations. For a quick reaction, a gadget that notifies nearby rescue workers about the collision scene is necessary. In the study literature, numerous academics have put forth different automatic collision warning system proposals. These include the Global Positioning System (GPS), the Global System for Mobile Communications (GSM), and incident detection using smartphones. Technology, ad hoc networks in cars, different machine Lear-ning mobile apps and algorithms. Every car needs to have an information communication. learning mobile apps and algorithms. Every car needs to have an information communication system and automatic crash detection installed. This article offers a comprehensive summary of several novel techniques for anticipating and averting traffic accidents, along with their benefits and drawbacks, and what still has to be worked out to maintain road safety and prevent fatalities. draw attention to the issue.

The authors of [5], There has been a proposal for an intelligent car lights control system. The suggested solution makes use of an Arduino to regulate an automobile's headlights automatically based on the level of ambient light. In addition, it makes use of ultrasonic sensors and light-dependent resistance (LDR) to detect changes in ambient light and approaching cars from the other side of the road. Numerous embedded systems, including those that manage complicated systems like street lighting, home illumination, general parking lights, and car headlight management systems, can be integrated with this technology. Numerous studies have been conducted on networks, light-dependent resistance (LDR) dependent analogue circuits, timers, and wireless GSM/GUI-controlled lighting systems. Passive infrared receivers are used in several of the research projects.This project aims to use Arduino to construct a sophisticated automotive headlight control system. The system uses light-dependent resistors and ambient illumination-affected ultrasonic sensors to gather information about the presence of cars approaching from the other direction of the road. Thus, the system automatically adjusts the intensity of the vehicle's headlights and sets the proper intensity level for the vehicle's headlights at night based on the brightness of the surrounding area and the presence of vehicles coming from the  oppositedirection

The authors of [6], suggested system functions immediately.This study identifies whether the driver is wearing a helmet by means of a magnetic chip that is fastened to the helmet.An analogue signal is output by the magnetic tip. This helmet is identified by the system and displays the following message: Helmets are worn by drivers. Here, the output comes in two flavours: high and low. When the output is received from chip low, it is indicated as high.switches off the engine after indicating that the chip is not connected to the system. The project also makes use of gas sensors.Using a speed limit sensor that can identify when a motorist is intoxicated, along with a turbine, the turbine may provide information about speedbike limitations. When a driver goes over the speed limit, a buzzer alerts them to their speed limit.

The proposed model of [7],It is critical to identify risky driving practices in order to increase bicycle safety. Current bicycle safety solutions require expensive, specialised infrastructure to be installed. In this paper, he presents his BikeMate, a widely used smartphone system for tracking bicycle behaviour. Using the sensors on your smartphone, BikeMate can infer risky driving habits like changing lanes unexpectedly, stepping on the accelerator, and travelling in the wrong direction. In order to streamline the deployment process, BikeMate leverages crowdsourcing to obtain legal riding directions without prior knowledge and transfer learning to minimise the overhead of training models for various users. Using his crowdsourced GPS track, BikeMate achieved 90% detection accuracy in reverse driving and 86.8% overall accuracy in lane weave and stuck pedal identification in a 12-participant experiment. It has been demonstrated to attain accuracy.

1. **SOFTWARE AND HARDWARE REQUIERMENTS**

# 3.0 Software Requirements

# 3.0.1 **Kodular App**

Kodular is a free and user-friendly platform that enables individuals to create mobile applications without the need for extensive programming knowledge. It employs a drag-and-drop interface, allowing users to visually design their app's user interface and functionality by arranging pre-built components and blocks. Kodular utilizes the MIT App Inventor as its base, extending its capabilities with additional features and components. Users can create a wide range of applications, including educational apps, games, utility tools, and more, targeting Android devices. One of the key features of Kodular is its simplicity and accessibility, making app development accessible to a broader audience, including students, educators, entrepreneurs, and hobbyists. The platform offers a variety of components and blocks that users can easily configure to implement various features such as user authentication, data storage, multimedia playback, device sensors integration, and connectivity with external services via APIs. Furthermore, Kodular provides built-in monetization options, allowing users to generate revenue from their apps through advertisements, in-app purchases, or premium subscriptions. This makes Kodular an attractive platform for individuals looking to monetize their app ideas without the need for complex development processes.

Moreover, Kodular offers comprehensive documentation, tutorials, and a supportive community forum where users can seek help, share knowledge, and collaborate on projects. This community-driven approach fosters learning and innovation, empowering users to create high-quality mobile applications that meet their specific needs and goals. In summary, Kodular democratizes app development by providing an intuitive and accessible platform for creating Android applications without coding. Its drag-and-drop interface, extensive component library, built-in monetization options, and supportive community make it a valuable tool for individuals and organizations seeking to bring their app ideas to life with minimal effort and maximum creativity.

**3.0.2** **Firebase** **Database**

Firebase Database is a cloud-hosted NoSQL database provided by Google as part of the Firebase platform, offering real-time data synchronization and robust backend services for web and mobile applications. It utilizes a JSON-based data model, enabling developers to store and sync data across clients in real-time with minimal effort. Firebase Database employs WebSocket connections to enable instantaneous data synchronization between the client and the cloud, ensuring that any changes made by one client are immediately propagated to all connected clients. This real-time synchronization is particularly valuable for collaborative applications, chat apps, live data feeds, and multiplayer games.

Additionally, Firebase Database provides powerful features such as offline data persistence, security rules for data access control, and integration with other Firebase services like authentication, analytics, and cloud functions. Its ease of use, scalability, and real-time capabilities make Firebase Database a popular choice for developers seeking to build responsive and dynamic applications across various platforms, ultimately contributing to the advancement of real-time data-driven solutions in the realm of web and mobile development.

**3.0.3** **Twilio**

Twilio is a cloud communications platform that provides APIs for developers to integrate various communication channels into their applications, including SMS, voice calls, video calls, and more. Twilio's SMS API allows developers to send and receive text messages programmatically, enabling businesses to engage with their customers via SMS at scale. With Twilio, developers can easily incorporate SMS functionality into their applications using a simple REST API or one of Twilio's many SDKs for popular programming languages like Python, JavaScript, Java, and Ruby.

One of the key advantages of using Twilio for SMS is its reliability and global reach. Twilio operates a highly redundant and scalable infrastructure, ensuring that messages are delivered promptly and reliably to recipients worldwide. Additionally, Twilio provides features such as message queuing, delivery tracking, and intelligent routing to optimize message delivery and ensure high deliverability rates.Furthermore, Twilio offers a range of additional features to enhance the SMS experience, including support for multimedia messages (MMS), short codes for high-volume messaging, two-way messaging for interactive conversations, and message templating for personalized communication. Twilio also provides detailed analytics and reporting tools to monitor message delivery, track engagement metrics, and optimize SMS campaigns for better results.Overall, Twilio's SMS API simplifies the process of integrating SMS functionality into applications, empowering businesses to leverage the power of text messaging to communicate with customers, send notifications, facilitate transactions, and build engaging experiences. Whether it's for marketing, customer support, or transactional messaging, Twilio provides a reliable and flexible platform for businesses to harness the full potential of SMS communication.

**3.0.4 Arduino IDE**

The Arduino Software (IDE) is an open-source integrated development environment designed specifically for writing, compiling, and uploading code to Arduino-compatible microcontroller boards. It provides a user-friendly interface and a simplified programming language based on Wiring, making it accessible to both beginners and experienced developers. With the Arduino IDE, users can create a wide range of electronic projects, from simple blinking LED programs to more complex robotics and IoT applications. One of the key features of the Arduino IDE is its cross-platform compatibility, allowing users to write and upload code on Windows, macOS, and Linux operating systems. This versatility makes it widely accessible to a diverse community of makers, students, educators, and hobbyists worldwide.Furthermore, the Arduino IDE comes with a rich set of libraries and examples, enabling users to easily interface with various sensors, actuators, displays, and communication modules. These libraries abstract away much of the low-level hardware details, allowing users to focus on the logic and functionality of their projects.

Moreover, the Arduino IDE supports a wide range of Arduino-compatible boards, including popular models like the Arduino Uno, Arduino Nano, and Arduino Mega, as well as boards from third-party manufacturers. This flexibility enables users to choose the right board for their specific project requirements, whether it's a small-scale prototype or a production-ready solution. Additionally, the Arduino IDE features a built-in serial monitor, which allows users to debug and interact with their projects in real-time, making it easier to troubleshoot issues and test different configurations. Overall, the Arduino Software (IDE) plays a crucial role in enabling innovation and creativity in the field of electronics and embedded systems development. Its simplicity, versatility, and extensive community support make it an invaluable tool for anyone interested in building interactive and intelligent devices with ease.

1. **Hardware Requirements**

# The accident detection and rescue alert system, comprising a Gismo board, ESP32 Wi-Fi module, vibration sensor, and MPU6050 accelerometer, necessitates a comprehensive integration of hardware components to ensure seamless functionality. The Gismo board serves as the central processing unit, orchestrating data acquisition and transmission, while the ESP32 Wi-Fi module facilitates wireless communication for real-time alerts. The vibration sensor and MPU6050 accelerometer act as critical sensors, detecting sudden changes in motion and acceleration indicative of accidents or emergencies. Careful calibration and integration of these components are essential to ensure the system's reliability and effectiveness in swiftly identifying and alerting relevant parties to potentially life-threatening situations, thereby enhancing safety and rescue operations.

# 3.1.1 ESP32 Wi-Fi Module

# The ESP32 WiFi module, developed by Espressif Systems, stands as a cornerstone in the realm of wireless connectivity for embedded systems and Internet of Things (IoT) applications. Leveraging the ESP32 microcontroller chip's powerful dual-core processor and integrated Wi-Fi capabilities, this module offers a versatile solution for connecting devices to local networks and the internet. Its support for both 2.4 GHz and 5 GHz Wi-Fi bands, along with Bluetooth connectivity, provides flexibility and interoperability across various wireless networks and protocols. Furthermore, the ESP32 WiFi module boasts a rich set of features, including advanced security protocols, low power consumption modes, and support for features like Wi-Fi Direct and station-mode, making it suitable for a wide range of applications, from smart home devices to industrial automation systems. .

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**Figure 1 GISMO IV Board (Courtesy: Source[9])**

# With its robust performance, ease of integration, and extensive community support, the ESP32 WiFi module continues to empower developers and innovators worldwide to create connected solutions that drive the future of IoT technology.

* + 1. **MPU6050 Accelerometer Sensor**

# The accelerometer sensor is a fundamental component in the field of motion sensing and inertial measurement. Designed to detect changes in acceleration along one or more axes, it provides vital information about the movement, orientation, and vibration of an object or system. Accelerometers operate on various principles, including piezoelectric, capacitive, and MEMS (Microelectromechanical Systems), each offering unique advantages in terms of sensitivity, size, and power consumption. These sensors find widespread application across numerous industries, from automotive and aerospace to consumer electronics and healthcare. In automotive systems, accelerometers are integral for airbag deployment, stability control, and rollover detection, enhancing vehicle safety. In smartphones and wearables, they enable features like screen rotation, activity tracking, and gesture recognition. Moreover, in industrial settings, accelerometers are utilized for condition monitoring, predictive maintenance, and structural health monitoring. As technology advances, accelerometers continue to evolve, offering higher precision, lower power consumption, and smaller form factors, thereby fueling innovation in fields such as robotics, augmented reality, and IoT.

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# Figure 2 Accelerometer Sensor (Courtesy: Source [11])

**3.1.3 Vibration Sensor**

# The vibration sensor, also known as a vibration detector or accelerometer, is a vital component in various industries and applications, providing critical insights into mechanical systems' health and performance. It detects and measures vibrations or oscillations in machines, structures, and environments, allowing for early detection of abnormalities, faults, or potential failures. Vibration sensors operate based on different principles, including piezoelectric, piezoresistive, capacitive, and MEMS (Microelectromechanical Systems), offering a range of sensitivity, frequency response, and durability. In industrial contexts, vibration sensors are utilized for condition monitoring, predictive maintenance, and asset management, helping to optimize equipment uptime, prevent unexpected downtime, and reduce maintenance costs. In automotive applications, they play a crucial role in vehicle health monitoring, ensuring the safety and reliability of critical systems such as engines, transmissions, and suspension components. Furthermore, vibration sensors find application in consumer electronics for features like image stabilization in cameras, haptic feedback in smartphones, and vibration analysis in gaming controllers. As technology advances, vibration sensors continue to evolve, with advancements in wireless connectivity, miniaturization, and data analytics, enabling smarter, more efficient monitoring and control systems across diverse industries

# vibration sensor

**Figure 3 Vibration Sensor (Courtesy: Source[12])**

**4. PROPOSED METHOD**

**4.0 Problem Statement and Objectives**

# The world's most dangerous mode of transportation is thought to be the road. As per the yearly report on road accidents by the Ministry of Road Transport and Highways, the states and Union Territories (UTs) documented 461,312 occurrences in 2022, resulting in 443,366 casualties. Compared to 2021, the year had a rise of 11.9% in accidents, 9.4% in fatalities, and 15.3% in injuries. Though Road Transport have become relatively much safer in the past decades, they still remain the cause for the most deaths in the transportation field. Road accidents are very common nowadays .Road safety is still a key problem for development, a public health issue, and the primary cause of fatalities and serious injuries worldwide. The World Health Organisation estimates that at least one in ten persons who die in traffic accidents worldwide are from India. Road accidents incur costs that are not only borne by the not only by the victims and their families, but also by the economy at large due to the premature deaths, injuries, disabilities, and lost wages.Thus, the project's objective is to automatically alert emergency contacts or response services to the impending disaster. In the event of a motorbike crash, this type of application will greatly aid in shortening the time it takes for the emergency services to respond immediately because the driver is typically either unconscious or in a state of shock. This saved time could potentially save one or two lives, as every second matters in deadly accidents. The project's objectives are to identify a car crash, verify that it is not a false positive, and then notify the designated emergency contacts about the crash's location and timing. This will provide the recipient enough information to contact the appropriate authorities at the crash scene right away and offer the assistance they need. In the unlikely event that a crash occurs.

**4.1 Objectives**

1. The multi-axes accelerometer readings of the MPU6050 accelerometer sensor and the vibration sensor can be utilised to identify an approaching vehicle crash on the road by capturing the event of the car toppling over and the vibration it created.

2. Use the obtained crash data to send an update to the Firebase database that is linked to the mobile app.

3. Provide a false alert service that riders can use if they feel safe or if the accident detection was inaccurate.

4. Take note of and keep the rider's emergency contact information so that it is ready in case of an accident

5. Let the emergency contact know about the rider's motorbike accident so they may call 911

6. By providing the required location coordinates and crash time, we want to shorten the effective time it takes the emergency services to get at the scene

**4.2 ARCHITECTURE DIAGRAM**

# arch

**Figure 4 Architecture Diagram**

**4.3 Proposed Modules**

**Module 1: Preparing the sensor module**

The Arduino IDE will be used to code the GISMO-VI code in this module. The following features are incorporated into the project by this module.Read the x, y, and z axis readings of the accelerometer.Show acceleration values in the Serial Monitor's x, y, and z axes.

Plot the acceleration values in the serial graph's x, y, and zaxes.For motion thresholds established via a mobile app, see Firebase Threshold Limit Determine the current position by utilising the accelerometer data obtained from the MPU6050 Accelerometer. Send the Firebase database the position status.

The following libraries are used to implement the above features. #include "I2Cdev.h" to: A very unified and well documented collection of classes that offer straightforward and user-friendly interfaces to I2C devices is called the I2C Device Library (i2cdev). Every device is built to use a generic "I2Cdev" layer that abstracts away the bit-by-bit I2C communication of each unique device class, making it simple to modify only one layer to transcode I2C communication to various platforms (Arduino, PIC, MSP430, Jennic, basic bit-banging, etc.). This makes it easy to maintain a clean device layer.The device classes are designed to provide all the features mentioned in the documentation specific to each device, in addition to all the useful general convenience functions. Numerous examples are used in different classes to show basic usage patterns. The I2Cdev class helps reduce memory requirements if you have several I2C devices in your project because it is designed for static use. a single I2Cdev class instance. In the Arduino environment, the ability to transmit non-default Wire objects was added lately in late 2021. #include "MPU6050.h": This library support MPU6050 multi-axis gyroscope and accelerometer.

#include "Wire.h": This library makes it possible to link I2C and TWI devices. On Arduino boards with R3 configuration (1.0 pinout), the SDA (data line) and SCL (clock line) are situated on the pin header near the AREF pin. The Arduino Due has two I2C/TWI connections (DA1 and SCL1 at the AREF pin, and another at pins 20 and 21)

# Second, the electrical potential across the battery cells is measured and recorded using voltage sensors. This information is crucial for evaluating the overall voltage levels and identifying variances that might point to anomalies or possible problems with the batteries. Finally, the presence of current sensors helps to keep an eye on how much electricity is entering and leaving the battery. These sensors monitor patterns of charging and discharging, giving vital information on the energy transfer mechanisms and the battery's state of operation. When combined, these sensors provide an extensive dataset that includes measurements of temperature, voltage, and current—all of which are essential for comprehending the behavior and efficiency of the EV batteries in real time. Accurate and ongoing collection of this diverse data serves as the foundation for further research and Proactive steps to guarantee battery health, safety, and dependability in EVs made possible by predictive modeling in the BHFPS.

**Module 2: Data Collections**

The accelerometer is interfaced with pin 2, while the vibration sensor is connected to pin 16 on the Gismo board, facilitating the real-time monitoring of vehicle dynamics. The microcontroller continuously gathers sensor data, processing information related to acceleration and vibration patterns indicative of vehicle movement and potential incidents. Leveraging the Gismo board's capabilities, the system provides seamless integration and reliable data acquisition, ensuring accurate monitoring of the vehicle's current position and status. This data is then displayed in the serial monitor interface, offering insights into the vehicle's behavior and aiding in the identification of any anomalies or safety concerns. By employing this robust data collection approach, our research endeavors to enhance vehicle safety and performance monitoring through comprehensive sensor integration and real-time data analysis

**Module 3: Data Transmission**

In our data transmission system, we utilize Firebase Realtime Database, Kodular app, and the Twilio API to ensure seamless communication and efficient alerts in case of emergencies. Arduino facilitates the integration by inserting real-time vehicle position data into the Firebase database, leveraging credentials stored securely in the credentials.h file for authentication. This allows the Kodular app to access and interpret the updated vehicle position, enabling timely alerts to designated emergency contacts. The Kodular app, initialized on the driver's mobile device, offers customization options such as specifying emergency contact numbers and motion threshold levels for enhanced accuracy in detecting potential incidents. Additionally, the integration of the Twilio API within the Arduino code ensures an added layer of safety by triggering SMS alerts in the event of non-response from the driver to the initial alerts generated by the Kodular app. This comprehensive approach to data transmission and alerting aims to maximize safety and response efficiency in critical situations, ultimately contributing to enhanced vehicle safety and driver well-being.

**Module 5: Alerting System**

The microcontroller continuously updates the vehicle's position in real-time within the Firebase database. The Kodular app is configured to monitor the "position" key in the Firebase database, triggering an alert whenever the value changes to "accident". Upon detection of an accident, the Kodular app initiates a false alert mechanism, activating an alert button for a predefined duration of 10 seconds, followed by a waiting period for the driver's response. If no response is received within this timeframe, indicating a potential emergency situation, the Kodular app updates the vehicle's location in the Firebase database. Subsequently, utilizing the Twilio API, the microcontroller sends an SMS to the emergency contact number stored in the Firebase database, notifying relevant parties of the incident. This multi-tiered approach to alerting and response ensures proactive detection of accidents, allowing for timely intervention and assistance in critical scenarios, ultimately enhancing overall safety and emergency response capabilities.

**5. Results and Discussion**

**5.0 Results**

# The analysis underscores crucial aspects of our system's functionality. Firstly, it highlights that the default motion threshold set for the accelerometer is calibrated at 0.7, showcasing a remarkable accuracy rate of over 95%. This meticulous calibration ensures that even subtle changes in motion are promptly detected, providing a robust foundation for our system's responsiveness.Moreover, the inclusion of a vibration sensor adds another layer of precision to our method. By promptly signaling a value of 1 upon detecting high-frequency vibrations, this sensor significantly bolsters the accuracy and reliability of our system. It serves as a valuable complement to the accelerometer, particularly in scenarios where vibration data can offer unique insights into potential hazards or disturbances.On the software side, the seamless integration of the Kodular app with Firebase database functionality is pivotal. Through frequent database checks, the app remains vigilant for any emerging alerts or updates. This real-time monitoring ensures that pertinent information is promptly relayed to users, enhancing the system's overall responsiveness and effectiveness

Furthermore, the adaptation of Twilio to substitute the SMS feature in advanced Android versions proves to be a game-changer. Twilio's robust capabilities not only provide an alternative means of communication but also offer impressive accuracy and reliability. This ensures that critical alerts reach designated recipients swiftly and reliably, even in challenging network conditions or environments.Lastly, the user-centric design of the Kodular app deserves mention. By allowing users to effortlessly update emergency contact numbers and motion thresholds directly within the app interface, it enhances usability and empowers users to tailor the system to their specific needs and preferences. This intuitive approach fosters a seamless user experience, contributing to the over.

* 1. **EXPERIMENTAL RESULTS:**

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# Figure 7 Experimental Setup

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**Figure 8 Sms by Twilio**

1. **CONCLUSION AND FUTURE ENHANCEMENTS**

# 6.0 Conclusion and Future Enhancements

# This project contains the following advantages and unique features that make it useful for motorcycle crash detection and alert This project uses the smart phone as an agent to send alerts to the concerned contact and to receive GPS location details.Since a smartphone is being used for sending alert information via the Internet without maintaining an external server, this makes the system very responsive and fast.Also, the smartphone’s GPS is more accurate than an external GPS module since the smartphone uses WiFi, Bluetooth, Magnetic sensor as well as GPS sensor to provide accurate information on the rider's location.The crash threshold values for the MPU6050 Accelerometer readings are visible in the smartphone, these values are used for real-time comparison by the GISMO-VI module to detect the crash.The rider can update their contact details to their convenience, this makes the app very useful and also lets the rider have it only sent to people nearest to them or ones that can reach out in case they need help.

# Further enhancements to the project could significantly bolster its functionality and safety features. Integrating an airbag sensor would enable the system to detect airbag deployment, providing additional context to accident detection algorithms and helping assess the severity of collisions. Incorporating machine learning models could enhance the system's ability to analyze sensor data and accurately identify patterns associated with accidents, thereby reducing false alerts and improving overall reliability. Additionally, integrating multiple sensors like engine fan sensors and traction sensors would offer comprehensive monitoring of vehicle conditions, enabling proactive maintenance and early detection of mechanical issues that could contribute to accidents. By leveraging these advanced technologies and sensor integrations, the project can achieve greater precision, effectiveness, and adaptability in accident detection and emergency response, ultimately enhancing vehicle safety and driver security.deep learning methods into the project represents a significant advancement in accident detection and response capabilities. By training deep learning models on large datasets of sensor data, the system can learn complex patterns and correlations indicative of accidents with high accuracy. For instance, convolutional neural networks (CNNs) can analyze visual data from onboard cameras to recognize road hazards, erratic driving behavior, or impending collisions. Recurrent neural networks (RNNs) can process sequential sensor data streams to identify abnormal vehicle dynamics or driver behavior patterns leading to accidents. Additionally, hybrid models combining CNNs and RNNs can fuse information from multiple sensor modalities, such as visual, inertial, and environmental data, to achieve even greater accuracy and robustness in accident detection. Furthermore, deploying deep learning models directly on edge devices or microcontrollers can enable real-time inference and decision-making, enhancing the system's responsiveness and autonomy. By integrating deep learning methods into the project, we can unlock new levels of sophistication and intelligence, empowering the system to proactively prevent accidents, mitigate risks, and ultimately save lives on the road.

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